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Challenges and options for animal and public health services in the next two decades

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The opinions expressed in this paper are of the author and not his employer.

Summary

Trade in livestock and livestock products makes up approximately one sixth of global agriculture trade. This trade is demand driven, primarily by growing human populations, changing economies, and consumer preferences in developing countries. Different rates of population growth, economic growth, urbanisation, environmental sustainability, and technology transfer will determine which countries will reap the greatest benefits. Global trends in demand and supply for food, not terrorism, will drive the future of animal and public health service delivery.

To benefit the greatest number of people and countries, animal and public health services should support policies that temper growing disparities among rich and poor countries, city and rural populations, and the sexes. Economic growth is critical to overcoming disparities between countries and best supported by integrated animal health, public health, labour, and foreign policies. Opportunities for job growth will be the greatest along the value added chain of food production and will require significant investments in science- (risk-) based education.

Keywords

Animal health service – Economic growth – Education – Environmental stewardship – Livestock – Livestock product – Poverty – Public health service – Trade – Urbanisation – Value added – Women.

Introduction

Already during the 'Green Revolution' livestock production was the fastest expanding sector of agriculture worldwide. Although much smaller in scope than arable agriculture, the increase in the livestock production index from the early 1980s to the late 1990s was consistently higher, in both middle- and low-income countries, than that of crops (Table I). Today trade in livestock and livestock products (LLPs) makes up approximately one sixth, by value, of all agriculture trade worldwide (11). Meat exports (mainly beef, pork, and poultry meat) represent about half the total value of the global livestock trade. As a group, developed countries account for more than three-quarters, in quantity, of the world trade in LLPs. Developing countries are net importers, and dairy produce is the largest single import item (11).

The steady growth in production, productivity, and trade in LLPs is demand driven in response to growing human populations, economies, and consumer preferences for meat and dairy products (3). These growth trends are associated predominantly with developing countries (Table II). Despite concerns in the developed world over the excessive intake of calories and fat, much of the developing world will benefit from increased food intake, especially food of animal origin (Table III). There is plenty of opportunity for increased production and consumption of food of animal origin in developing countries. The growth of the livestock industry presents animal and public health services with the major challenge of

Table I
World crop and livestock production indices (base 1980)

Country income category	Crops		Livestock	
	1979-1981	1998-2001	1979-1981	1998-2001
Middle Income	74.5	128.2	69.3	153.7
Difference between periods	53.7		84.4	
Low income	71.6	124.4	68.4	131.2
Difference between periods	52.8		72.8	

Source: World Bank (13)

providing a scientific and regulatory framework that will meet increasing demand for and production and consumption of LLPs in all countries.

Overall, the trends for production and consumption of food of animal origin are positive and represent macro shifts in demand for and production and consumption of LLPs in the world. However, not all countries will benefit to the same degree from these positive trends because there are equally magnanimous factors that will affect the impact of these trends in different countries. In general, factors affecting differences in the effect of these changes between countries are related to population growth, economic growth, urbanisation, environmental sustainability, and the use of and access to new technologies. The different rates at which these factors change and the degree to which countries and industries seek a competitive advantage will determine the extent of disparities in economic growth, purchasing power, and food consumption between high-, middle-, and low-income countries over the next twenty years. If these trends continue as predicted, the resulting changes in demand for and supply of food of animal origin among different countries will probably be prominent forces shaping the expectations and delivery of veterinary and public health services throughout the world.

Table II
Actual and projected meat consumption by world region

Region	Annual growth of total meat consumption (percent)		Total meat consumption (million metric tons)		
	1982–1994[a]	1993–2020[b]	1983	1993	2020
People's Republic of China	8.6	3.0	16	38	85
Other East Asia countries	5.8	2.4	1	3	8
India	3.6	2.9	3	4	8
Other South Asia countries	4.8	3.2	1	2	5
Southeast Asia	5.6	3.0	4	7	16
Latin America	3.3	2.3	15	21	39
West Asia/North Africa	2.4	2.8	5	6	15
Sub-Saharan Africa	2.2	3.5	4	5	12
Developing world	5.4	2.8	50	88	188
Developed world	1.0	0.6	88	97	115
World	2.9	1.8	139	184	303

a) actual data
b) modelled data
Source: International Food Policy Research Institute (3)

Table III
Average daily food intake per person in countries with different income levels (1997)

Country income level	Calorie intake per day	Protein intake g/day (% increase since 1970)	Fat intake g/day (% increase since 1970)
Low	2,166	65 (30.7%)	55 (96.2%)
Middle	2,743	78 (17.6%)	76 (39.5%)
High	3,371	105 (14.3%)	134 (22.4%)

Source: United Nations Development Programme (10)

For animal and public health services to contribute constructively to global development in the future these services will have to assume a mediatory as well as a regulatory role. This will probably require animal and public health services to support policies that temper growing inequalities and include preferential opportunities for low-income countries, rural populations, and women.

It is likely that the current functions of animal and public health services will be insufficient to meet those demands. Rather members of the animal and public health services will have to engage in an economic and social debate to identify choices that best serve all parties equitably.

Economic growth

Per capita gross domestic product (GDP) is lowest in countries with high rates of population growth and high rates of population growth are positively associated with the proportion of GDP derived from agriculture (Table IV). This is because many low- and middle-income countries derive much of their GDP from agriculture. For example, low-income countries derive on average 26% of their GDP from agriculture, but developed countries, such as countries in the European Union, derive only 2% of their GDP from agriculture. In countries where agriculture makes a large contribution to the GDP, a large proportion of the workforce is employed in the agriculture sector. Low-income countries generally employ over 50% of their population in agriculture, middle-income countries employ on average less than 40% of their population in agriculture, and approximately 4% of the population in high-income countries work in the agriculture sector. Furthermore, less value added occurs in agriculture in low-income countries compared to high-income countries and even less value added is generated as the agricultural contribution to a country's GDP increases. This low productivity is in part due to low-income countries having the lowest levels of mechanisation (number of tractors, machines, and mechanised transportation) to manage crops (Table V), and having to rely more heavily on physical labour to plant and harvest crops. These factors result in low rates of economic growth within poor populations and effectively create a vicious cycle of poor economic growth and lack of opportunity. Disparities between countries, such as those listed in Tables IV and V, are reflected in a growing gap in the vitality of high and low-income countries.

Table IV
Projections of population growth and urbanisation, and indicators of agricultural economic power in countries with different income levels

Country income level	1975	1998	2015
	Per capita gross domestic product (US $)		
Low	350	2200	n/a
Middle	2,160	6,110	n/a
High	6,200	23,100	n/a
	Population (millions)		
Low	2,268.9	3,499.9	4,389.0
Growth rate (%)	1.9	1.3	
Middle	1,001.9	1,455.8	1,740.2
Growth rate (%)	1.6	1.1	
High	746.6	864.1	911.1
Growth rate (%)	1.1	1.1	
	Urban population (% of total)		
Low	19.0	30.8	41.6
Middle	52.7	65.9	72.9
High	75.0	78.2	81.9
	Percentage of population working in agriculture		
Low	66 (1970)	64	60
Middle	54	40	18
High	ND	2	2
	Contribution of agriculture sector (% of total) to gross domestic product		
Low	43 (1970)	26	23
Middle	20 (1970)	10	10
High	18	8	5

Sources: United Nations Development Programme (9) and World Bank (17)

The role women play in society is critical to economic growth in low-income countries because women represent on average 50% of a nation's capable workforce and account for an even greater proportion of the labour force in the agriculture sector. In low-income countries, women make up over 70% of the labour force in agriculture, whereas women only make up 22% and 7% of the agriculture workforce in middle- and high-income countries, respectively (13). High rates of population growth are, in turn, often associated with low levels of education and unequal rights of women. In low-income countries, the literacy rate of females is only 76% of the literacy rate of males, while in middle-income countries it is 94% (13). These associations have huge implications for animal and public health services because providing education and employment opportunities to women is critical to break the vicious cycle of poverty and lack of opportunity in low-income countries.

If animal and public health services cannot facilitate education and employment opportunities to low-income countries, rural populations, and women and improve poverty in the next two decades, these services will probably be used preferentially by wealthy countries and industries. In this case, animal and public health services will be simply bystanders to a widening of the gap between countries that already have an excess of resources and countries with few resources, which, in turn, could render animal and public health services redundant. The purpose of this article is to illustrate some ways in which animal and public health services may be able to play a strategic role in equalizing opportunities between countries as the global demand for foods of animal origin continues to grow.

Table V
Mechanisation within the agriculture sector in countries with different income levels

Country income level	Tractors per 1,000 agricultural workers		Tractors per 100 hectares of arable land	
	1979-1981	1996-1998	1797-1991	1996-1998
Low	2	5	20	69
Middle	8	11	103	126
High	519	927	896	953

Source: World Bank (12)

Urbanisation

The projections for urbanisation are that low- and middle-income countries will have massive cities in the foreseeable future. Although the proportion of the population living in urbanised areas is the lowest in developing countries, the much larger populations of these countries indicates that the future cities in developing countries will be the largest in the world (Table IV). The factors driving urbanisation are limited access to jobs, economic growth opportunities, health services and education; poor infrastructure in rural areas; and the perception that cities will bring good fortune.

Animal and public health services can do two things to adjust to the projected trends in urbanisation: provide a framework for job growth in food safety and handling within the cities and support job growth along the value added chain in rural areas. (The value added chain involves jobs within the processing sector of animal food products, mainly related to sales beyond the farm).

Framework for urban employment

In cities there is and will continue to be a huge demand for services that ensure the safety of food and adequacy of food distribution. Providing safe and abundant food is essential for a vigorous workforce, without which cities cannot prosper. There will be a demand for the creation of new jobs in food safety and handling in the areas of food processing, packaging, distribution, storage, and retail, with the objective of providing 'just-in-time delivery' of food to the cities. Massive training initiatives will be required to re-educate professionals and educate persons entering new jobs in food safety and handling. Development of performance standards for new positions, training curricula, and training of teachers and management experts should be the responsibility of the animal and public health professions, and, by requiring appropriate standards, these services will secure the commitment of the public and private sectors, and with that facilitate the creation of new jobs.

Value added employment opportunities

A lack of access to infrastructure is a major hindrance to economic vitality in rural areas, especially for areas with agriculture systems that depend heavily on a functional transportation infrastructure to deliver goods to markets. Costs of transportation depend on the condition of the transportation routes and, in many cases, the cost of energy (fuel) delivery to rural areas to power vehicles. The costs of transportation and fuel have to be recovered in the sale price of goods, which under the conditions prevalent in many developing countries are high and unattractive to city customers. As a result of the high cost of domestically produced food, cities seek alternate sources of food from overseas that can be delivered cheaply and in bulk to the burgeoning populations. The high price of domestically produced food in low-income countries places rural areas at a considerable disadvantage with the imported food market. The low demand for domestic food produced in rural areas, where purchasing power is already low, is a significant disincentive for economic growth in rural areas.

To break the cycle of high cost of production and low demand for expensive domestically produced foods, either rural infrastructure has to improve or energy delivery costs have to decrease. A potential solution lies in generating biofuels (ethanol and biodiesel) in rural areas to provide a cheap source of energy on-site. Ethanol is a high octane alternative to petroleum-based fuels and can be produced economically using locally produced crops, such as sugar cane, cassava, and switch grass. Local production and substitution of petroleum-based fuels with biofuels will promote mechanisation of agriculture and lead to the development of infrastructure from within rural areas. Furthermore, by-products of biofuel production, such as brewers grain present additional opportunities. Brewers grain can be used as animal feed to support the development of local livestock production and animal waste can be recycled into methanol. Hence, biofuels and livestock production are intricately linked and animal and public health services should become engaged in the development of integrated biofuels/livestock industry complexes. Specifically, increased livestock production will create a demand for animal and public health services in

rural areas to support the expanding livestock production and help improve the productivity of the livestock enterprises. Furthermore, while cities will probably continue to import food, local production and consumption of domestically produced food will support the growth in jobs in food processing in rural areas. Increasing the availability of food in rural areas is an important factor contributing to the vigour of the workforce (5).

Environmental stewardship

Similar to the need for animal and public health services to facilitate opportunities for job growth in cities and rural areas, opportunities for economic development need to be created through environmental stewardship. Agriculture has large-scale impacts on water, soil, and air. In low- and middle-income countries, the percentage of land area used for arable and permanent cropland is increasing (Table VI), and in developing countries agriculture accounts for most of the freshwater withdrawals. These trends are the opposite of those seen in high-income countries where the amount of land used for agriculture is decreasing and industry utilises the greatest amount of water (Table VI).

To reduce the adverse negative environmental impacts of agriculture on water, soil, and air, wide area solutions have been proposed (7). In addition to risk dispersion models, economic models need to be developed to convert the economic externalities of farm waste production into jobs, such as waste management, recycling, and water conservation. Although internalising the costs of meat production may initially increase the cost of meat, over the long term, employing more people will increase purchasing power and lead to greater environmental sustainability. Also, as the amount of land used for agriculture increases, additional animal and public health experts will be needed to identify, respond to, and control new and emerging diseases. Pristine bat and other wildlife habitats that are encroached upon by the expansion of the agriculture sector may expose naïve populations of humans and animals to diseases, such as severe acute respiratory syndrome (SARS), Nipah virus, and Hendra virus.

Technology

Technological advances are expected to occur in diagnostics, correlating genetic markers in livestock with production, product tracing, informatics, and vaccine development. These technologies will be widely adopted if they can be shown to reduce the costs of production and trade. The role of animal and public health services will be to keep abreast of the emerging technologies and facilitate rapid and broad application of new technologies, while, at the same time, protect the intellectual property rights of the originator of the idea(s) and credit the principal source (e.g. genetics) of the intellectual property. It is important that animal and public health services are educated about new technologies so that these organisations can give countries of all income levels optimum early opportunity to take advantage of new developments.

It is foreseeable that the application of these new technologies will lower the marginal costs of trade by making it easier to verify the disease status of individual shipments of LLPs, instead of relying on the disease status of a country as a basis for safe trade, and will effectively create a basis for compartmentalisation of diseases for trade purposes. If countries agree to use such technologies, it is likely that rapid expansion of the production of LLPs could occur, which will offer countries that are able to use this type of technology an economic advantage over countries that are unable to apply the technology.

If access to cost-saving technology is not made generally available, the intended purpose of many regulations could be defeated simply because of relative cost differences in using the technologies between high- and low-income countries. In the worst-case scenario, differences in the relative cost of the technologies between countries could

Table VI
Comparison of the percentage of land area used for arable and permanent cropland and water withdrawal between countries with different income levels

Country income level	Percent land for arable cropland		Percent land for permanent cropland		Percent annual water withdrawal by sector		
	1980	1998	1980	1998	Agriculture	Industry	Domestic
Low	11.8	13.0	1.0	1.4	87	8	5
Middle	7.9	8.9	1.0	1.0	74	13	12
High	12.0	11.8	0.5	0.5	30	59	11

Source: World Bank (14, 15)

lead to two categories of trade partners: countries that trade under the Agreement on the Application of Sanitary and Phytosanitary Measures (SPS Agreement) and countries that trade in spite of the guidelines of the SPS Agreement. There are indications that this distinction may already be occurring, reflected by a trend indicating increasing trade of animals and animal products from FMD-infected countries with FMD-free and other FMD-infected countries (Fig. 1). For animal and public health services to play a meaningful role, these services will have to strive to make emerging technologies equally available to countries of different economic status.

There are, of course, many predictions about which particular technology will emerge and play a role in livestock production, public health, and international trade. However, it is not helpful for animal and public health services to speculate on which individual technologies will be adopted in the future because the type of technology adopted will be determined by prevailing economic forces. It would be of greater benefit for animal and public health services to identify the greatest constraints facing countries and to take a leadership role in promoting advancement of products that will benefit the maximum number of people. One of the greatest opportunities for leadership is support for a onetime vaccine against Newcastle Disease, a disease which is probably responsible for more loss of animal protein than any other animal disease in the world.

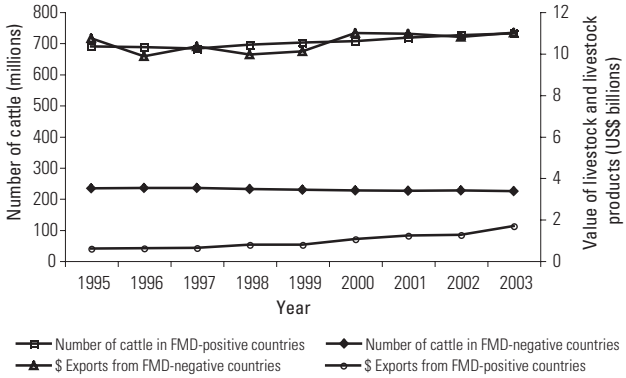


Fig. 1
Number of cattle and value of livestock and livestock product exports grouped by country foot and mouth disease status
Sources: OIE Handistatus II, UN Trade Statistics, FAOStat Agricultural data

Livestock trade

Approximately 75% of the world's cattle live in low- and middle-income countries; however, exports from these countries account for less than 15% of the global value in LLP trade. Part of the reason for this paradox is that many countries in the developing world have cattle infected with FMD (and many other diseases that restrict trade) (Fig. 1).

This paradox of supply and value in LLP trade is a reflection of unequal opportunities between countries for the trade of livestock and livestock products related to a country's animal disease status. Unequal opportunities result from differences in relative costs that are incurred for a country to become disease free and, once free of disease, to prove and maintain disease free status. Although absolute costs may be similar for all countries, these costs can be proportionately large for low- and middle-income countries and small for high-income countries. In other words, animal and public health services are not available at an equal relative cost to countries with different levels of income and, therefore, potentially this discrepancy presents a preferential advantage to the users of animal and public services in countries with a high-income status.

The role that animal and public health services can play to reduce relative cost differences is to become an equalizing force by providing a fair regulatory framework for trade. If this role is not adopted, the services may be utilised only by countries and industries that can afford them and become redundant in those which cannot. As animal welfare standards for trade continue to progress, great care will have to be taken to prevent animal welfare standards from creating an environment in which countries that cannot meet certain standards are discriminated against.

Animal and public health services can help overcome disparities between low- and high-income countries through efforts supporting mutual accountability. Mutually accountable programmes utilise the expertise and resources of participating partners and involve collaboration, interdependency, and sharing of responsibilities between countries. Both partners are, thus, mutually accountable for the outcome. For example, a mutually accountable approach to risk assessment utilises the local expertise within a country of origin to elucidate risk factors and the importing country assists with analytic analysis. The establishment of mutually accountable programmes does not require changes to the SPS Agreement. Rather, it requires the leadership in the animal and public health service communities to accept mutual accountability as a viable approach to build on partners' strengths and to reduce differences in the relative costs of trade. Promoting programmes of mutual accountability in which the exporting and importing countries share their expertise and strengths in risk management will lead to an overall reduction in the costs of trade, create economic opportunities for exporting countries, and increase variety in the diets of the importing countries.

Value added export

As with many economic principles, trade has winners and losers. Those in favour of trade will argue that trade is universally positive, in part because exports provide added value to the economy. However, this argument is not equally applicable to all aspects of all economies. In a flourishing economy, such as the United States of America (USA), it is estimated that every US$ 1 million value added to agricultural commodities (crops) through exporting meat supports approximately 5,000 domestic jobs. In the USA, this large number of jobs is thought to be, in part, a result of livestock practices in which cattle are fattened on corn and soy diets (in economic terms beef is value added to arable commodities) and sales of packaged meat. Similar observations are reported for poultry exports from Brazil and swine exports from Taipei China. In all cases, much of the value added chain supports employment beyond the farm gate, such as jobs related to fattening livestock; livestock transportation; and processing, packaging, distribution, and retail of livestock products. For example, it is estimated that value added to agriculture supports as many as 16% of all jobs in the USA, which makes agriculture the nation's single largest economic sector. Under these conditions, even though the individual producer benefits little directly from trade, the economy benefits as a whole. Thus, although the agriculture work force constitutes less than 5% of the country's population, the large number of jobs supported by agriculture leads to broad-based support for exporting agriculture goods.

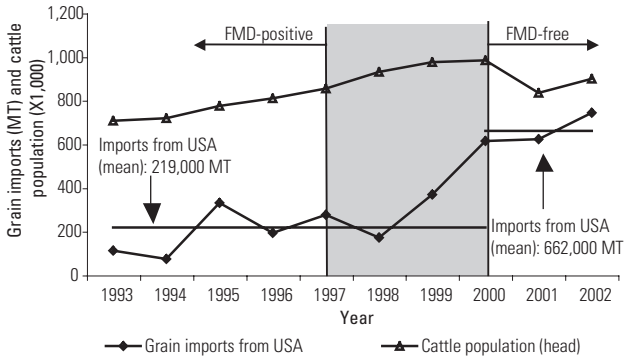
In contrast, in countries where large populations are directly employed in agriculture; livestock are pasture raised; and diseases, such as FMD, are frequently present and can lead to trade restrictions; little value is added to the economy as a result of LLP trade. The low value added manifests predominantly as trade in live animals rather than processed meat (Table VII).

A role for animal and public health services is to promote value added LLP production and trade by practices that increase productivity, such as feeding cheap imported feed. However, underlying successful value added programmes is disease control. Disease control programmes reduce trade restrictions and this provides a long-term incentive to improve productivity of livestock. The effects of successful disease eradication can be illustrated using a recent example in Syria (Fig. 2). When Syria became free of FMD in 2000, the country dramatically increased feed grain imports; cattle numbers did not increase but production rose incrementally. In other words, eradication of FMD in

Table VII
Comparison of live animal and processed meat exports from countries with and without foot and mouth disease

Species	Export value ($ X1,000)		Proportion of global exports		Proportion of live versus processed commodity exports	
	FMD-free	FMD-infected	FMD-free	FMD-infected (%)	FMD-free	FMD-infected (%)
Cattle (live)	2,126,426	93,609	18.4	0.8	20.1	9.7
Beef (processed)	8,435,267	872,424	73.2	7.6	79.9	90.3
Sub-total	10,561,693	966,033	91.6	8.4	100	100
Pigs (live)	634,302	309,697	7.1	3.5	7.9	34.6
Pork (processed)	7,369,407	586,456	82.8	6.6	92.1	65.4
Subtotal	8,003,709	896,153	89.9	10.1	100	100
Sheep (live)	318,512	115,938	15.3	5.6	16.6	71.2
Mutton (processed)	1,595,730	47,001	76.8	2.3	83.4	28.8
Subtotal	1,914,242	162,939	92.1	7.9	100	100
Goats (live)	8,797	30,826	12.4	43.5	27.2	80.0
Chevron (processed)	23,597	7,697	33.3	10.9	72.8	20.0
Subtotal	32,394	38,523	45.7	54.4	100	100
Total live animals	3,088,037	550,070	13.7	2.4	15.1	26.7
Total meat	17,424,001	1,513,578	77.2	6.7	84.9	73.3
Total	**20,512,038**	**2,063,648**	**90.9**	**9.1**	**100**	**100**

FMD: foot and mouth disease
Sources: OIE Handistatus II, UN Trade Statistics, FAOStat Agricultural data (1995-2003)



Shaded area denotes the final stages of the FMD eradication programme, when the country was either FMD-free with vaccination or free without vaccination, but still under intensive surveillance to prove freedom of disease

Fig. 2
Changes in feed grain imports (from the United States of America) and cattle numbers following the declaration of FMD free status in Syria in 2000

Syria led to improvements in livestock productivity. More meat was produced from a similar number of cattle, therefore, increasing protein availability and the added value of the cattle to the economy. As stated earlier these benefits accrue over the long term and, hence, sustained support for the policies underlying the advancements is required. This support can only come from ensuring hiring of permanent and experienced staff in animal and public health services.

Marginal costs

Another argument in favour of trade is that the marginal costs associated with exports can also have an effect on the domestic market by increasing local prices and improving farmer profits. Marginal costs of trade are the costs associated with establishing and maintaining export markets. Verifying the animal disease status within the exporting and importing countries accounts for a portion of the marginal costs. In effect these costs are the product of the SPS Agreement. Exporters are happy to pay these costs because global markets often offer a more secure outlet for sales than domestic markets and because the higher price paid on the international market covers the additional costs. Sales to stable customers and the opportunity to save costs by selling in bulk encourage many large-scale producers in low-income countries to preferentially sell their products on overseas markets. The domestic buyers are, thus, forced to compete with international traders who are willing to pay a higher buying price, which enables producers to charge more on the domestic market as well.

However, different relative marginal costs of exports on domestic prices have different implications in high- and low-income countries. In high-income countries the higher domestic prices for meat resulting from trade are small when compared to the average cost of food, and because of the value added effects the economy as a whole benefits. In contrast, in many developing countries increases in domestic meat prices have the potential to lower purchasing power and many people with an already limited income may be denied easy access to abundant local supplies of food (meat and dairy products). Furthermore, in developing countries that rely heavily on agriculture as the GDP, the increase in domestic food prices that result from the marginal costs of trade can disproportionately and negatively affect large numbers of poor people in rural areas (7). Trade can, thus, worsen the state of poverty and because many of the poor employed in agriculture are women can further suppress opportunities for women.

All countries have to weigh the costs of disease control and eradication against investments in other programmes. In low-income countries, meeting SPS requirements through disease eradication programmes can lead to higher domestic prices for food, which is a strong disincentive to the implementation of other similar programmes. In contrast, control programmes, such as vaccination campaigns, directly support jobs and maintain purchasing power. Regrettably, this is true even if the programmes are ineffective at controlling disease. In the long term, however, ineffective disease control programmes are detrimental to economic growth because the horizon for growth is limited. To overcome the disincentives for trade and turn livestock exports into a viable export commodity, countries have to invest in jobs in domestic agriculture-allied industries that allow people to gain from employment through the value added of exports.

The role of animal and public health services in developing countries is to support policies that facilitate job creation in the value added chain of food production. Options for increasing jobs in animal and public health services in cities and rural communities have been discussed in the preceding sections of this paper. To create new opportunities for job growth, animal and public health services should strive to have coherent labour, trade, and agricultural policies.

Disease outbreaks (accidental)

Although there is much concern and talk about the impacts of intentional versus accidental introductions of disease, much of this discussion fails to acknowledge that acts of terrorism are a minor driving force for change compared to the massive global changes in consumer food demands resulting from shifts in population demographics and economic opportunity. Ultimately, it is these global trends,

not terrorism, that will drive the adaptation of animal and public health service delivery.

There is also a tendency to overlook considerable differences in the likelihood that a particular country will be a target of terrorism, the capability of a country to respond to disease outbreaks, and the political will of a country to eradicate or live with a disease. To remain relevant in the debate on disease introductions and subsequent control and eradication, animal and public health services will need to consider these and other factors.

Political will

Political will reflects political priorities and is the willingness of decision makers to support and implement programmes. Several situations in which the political will of a country could have more strongly supported disease control measures exist. For example, in the United Kingdom (UK) the cost of direct subsidies to producers was in direct competition with the cost of implementing FMD eradication measures and may have played a role in the delayed response and large number of animal deaths during the FMD outbreak in 2001. In Taipei China, public concerns over the negative domestic environmental impact of swine farm waste resulting from animals produced for export have compromised the political will to eradicate FMD since 1997. In the USA, animal rights proponents brought about court rulings to override established control measures to limit the spread of equine infectious anaemia in New Mexico in 1994. The new rulings allowed foals to be kept alive for life long observation. Political will that is supportive of animal and public services will most likely be gained through studies that demonstrate transaction and opportunity costs associated with animal and public health service programmes that are superior to costs related to other programmes.

Transaction costs

Typically the costs associated with disease eradication are presented as cost tallies, i.e. summaries (counts) of expenditures related to disease outbreak response measures. However, these estimates do not measure the true cost of an outbreak response. During the response to a disease outbreak money is transferred from agriculture to other sectors of the economy, e.g. from paying farm labour (agriculture sector) to paying technicians to euthanize animals, dispose of carcasses, and clean and disinfect premises (service sector). Yet, because the money remains in the economy as a whole, the immediate costs to a country from the response to a disease outbreak are not indicated by the tally but rather by the cost of transferring money from one sector of the economy to another. These costs are the transaction costs, and there are very few estimates of transaction costs in agriculture. The FMD hoax of 2005 in New Zealand provides one example of transaction costs associated with a potential disease outbreak. The response to a letter threatening the introduction of FMD cost over US$ 2 million. All of these costs were associated with money transferred from the agriculture sector to the service sector, and none of the costs were associated with disease control operations.

Opportunity costs

Once money has been transferred from one sector of the economy to another sector, the final analysis has to be a comparison between the returns of investing in agriculture by supporting the response to a disease outbreak versus investing in other sectors of the economy. Because agriculture is typically not as productive a sector as, for example, the manufacturing or service sectors, the long-term costs (or gains) from relocating investments from agriculture to a different sector of the economy begs the question in which sector of the economy is the money most productive and over what time period do these comparative advantages exist. The answer to this question directs the political will that dictates in which sector investment would be more beneficial to the economy as a whole.

Tipping points

As countries progress economically, they rely less on agriculture as a source of national revenue and employment and other sectors add greater value added to the economy than agriculture (16). This change can consequently alter political will and can have dramatic and unexpected influences on the level of support politicians are willing to provide for animal and public health programmes. For example, the response to FMD in the UK has been questioned technically and scientifically and the slow response time to the outbreak resulting in excessive animal deaths was widely criticised. However, many of these criticisms overlook the political situation in which national policy decisions and political will were major determinants. In the UK, in 1999 the agriculture sector provided only 1% of value added to the GDP, whereas the services sector added 74% value to the GDP (16). Furthermore, in 2000 although agriculture added £6,617 million value to the overall economy, £2,187 million (33.1%) of this amount was redistributed to livestock farmers in the form of subsidies (4). Therefore, when the FMD outbreak occurred in the UK in 2001, the country was at a tipping point, and the extensive culling programme to control FMD resulted in a reduction of subsidy payments to livestock farmers of £264 million, an amount then available to other economic sectors with greater potential to add value to the overall economy than agriculture.

In large disease outbreaks politicians have to decide which choice will do the least harm or have the greatest economic benefit. The opportunity costs of placing resources into disease control versus other programmes becomes a tipping point for decision making: when the transaction costs of disease control become greater than the opportunity costs for disease control, the decision by a country to live with the disease becomes an economically viable option. Living with an animal disease is a feasible option for countries in which the livestock sector provides only a small contribution to the nation's GDP, either because the sector is small in size or because it contributes little value added.

The future credibility of animal disease control programmes will probably depend on long-term studies that allow true comparisons of transaction versus opportunity costs. Support for the notion that freedom from disease is automatically better is fading because of expectations that disease control and eradication programmes should result in more than a zero sum gain to a country. Also, a continued reliance on tallies to estimate the cost of animal disease outbreaks will mean that decisions and actions to control disease outbreaks will continue to be made in a highly charged political setting. A politically charged environment frequently lacks adherence to a vision, which is why politically based decisions have a strong potential to discriminate in the allocation of resources and give preference to those special interest groups with the most immediate access to decision makers. In the future, support for disease outbreak response, control, and eradication programmes will depend increasingly on the ability of animal and public health services to demonstrate the beneficial aspects of disease control programmes through long-term holistic benefit–cost analyses.

Holistic long-term economic analyses present a fertile ground for animal and public health services to remain viable and credible in the eyes of decision makers. These types of studies allow for the comparison of the true cost of disease control programmes with other emergency and non-emergency programmes and provide a better understanding of who benefits and who loses from disease control measures. Knowing which groups gain or lose in disease outbreaks helps identify principal stakeholders and decision makers who would need to be consulted during a disease outbreak and allows for early engagement of these groups during a response.

Existing animal health status and infrastructure

It is important to remind ourselves that all high-income countries that have recently been infected with a new animal disease and that had the political will to implement disease control measures have been able to eradicate the disease. This is likely to remain the case because high-income countries can usually absorb the transaction costs of disease eradication into their existing animal health infrastructure and the economy as a whole.

The situation is different for low- and middle-income countries in which diseases may already be endemic or epi-endemic and the diseases often reside in livestock owned by poor people who are politically marginalised and live in dispersed, inaccessible, or remote areas. An issue confounding the interest in controlling diseases of trade is that many diseases of trade, such as FMD, have limited impact on the production and productivity of small-scale farmers, e.g. a producer is only adversely affected if a cow aborts or a draught animal is infected when it is needed for ploughing. Hence, control of diseases of trade is often not a high priority for small-scale farmers. Small-scale farmers are usually more concerned with access to clean water, maternal health care, and education of their children, all of which directly affects the health and prospects of the farmers and their families. Animal diseases, such as Brucellosis, coenuriasis, and oncocerciasis, may be much more important to small-scale farmers than diseases of trade. The chronic and zoonotic nature of these diseases can have large-scale impacts on the economic potential of local communities and families (8). Animal and public health services have to consider these priorities when attempting to control diseases of trade in small-scale farms.

In spite of the poor conditions in many developing countries, when a disease outbreak occurs, the country is often capable of responding to the outbreak. For example, when FMD resurged in South America or when SARS emerged in Asia, the countries and the international community mounted effective responses that brought the disease under control. Regrettably, response alone is insufficient to break the vicious cycle of outbreak and response and may actually exacerbate it because the outbreak response cycle invariably favours producers that are the best prepared and protected. The best prepared and protected producers are large-scale farmers who often have safety networks, such as wealth that is diversified in a multitude of investments, and are, hence, already less vulnerable to an outbreak than small-scale farmers who have much of their wealth invested in livestock. As a result of this differential burden, the risk of adverse consequences to the livelihood of wealthy producers is less than the risk to small-scale farmers, and this disparity in preparedness capabilities of large- versus small-scale farmers increases with repeated outbreaks.

In extreme cases and over repeated outbreak response cycles, the differential capability of recovering from a disease outbreak results in the livestock industry being restructured and consolidated, which favours large-scale enterprises and leaves many small-scale producers with fewer resources for disease control than they had before the

outbreak and in some cases dropping out of production all together (1). This situation increases the risk of disease outbreaks if the source of disease is retained in livestock owned by poor small-scale farmers and international traders maintain and expand susceptible herds in the same agriculture system. It should not come as a surprise that under these conditions small-scale farmers develop a sense of resentment towards decision makers who prioritise disease control programmes for diseases of trade instead of focusing on disease control programmes that are important to the small-scale (artisan) farmers. The role of animal and public health services, therefore, is to break the outbreak response cycle by linking policies that protect the livelihoods and needs of the poor and control diseases of trade.

The solution to limiting the segregation of livestock production between the rich and the poor is to institute programmes and economic policies with mutual accountability. For example, wealthy countries and farmers should provide technical assistance to low- and middle-income countries, but rely on these countries to implement the programmes themselves. Wealthy countries and farmers should link disease identification and eradication efforts to economic opportunities for the poor. This can be done by engaging the private sector and providing farmers with incentives to participate in disease control programmes. For example, government officials who already have secure jobs should play only a limited role in the operational aspects of disease control and eradication because these measures (e.g. stamping out) effectively remove the livelihood of the affected farmers, whose herds are probably the principal source of income, and it is these farmers who need jobs (income). A better solution is for animal and public health service officials to contract the private sector, including farmers, to conduct the operational aspects of disease control. Government services should maintain official oversight to ensure adherence to standards. Such mutual accountability models provide the framework for disease outbreak response, control, and eradication programmes and, through providing incentives for interdependent and proportionate economic activities, enhance economic opportunities for all involved parties.

Impacts beyond the livestock sector

Large-scale disease outbreaks have implications that go beyond the livestock industry. For example, a widespread outbreak of FMD in North America could potentially impact the national grain industry, which, in turn, could have widespread global consequences. The USA supplies approximately 70% of the world's feed grains (Fig. 3) and is a major supplier of feed grains to the livestock industry in Canada and the USA (livestock in Canada and the USA are finished on corn and soy diets). Thus, if North American livestock were infected with FMD, huge volumes of feed grains would become available on the global market as a result of stamping out procedures and poor feed conversion. The excess amount of feed grains on the global market could destabilise global soy and corn prices for many years, much to the detriment of developing countries trying to compete in global agriculture commodity markets.

Disease outbreaks in countries that purchase large volumes of feed grains also have large impacts on the supply and prices of global feed grains. For example, since the FMD outbreak in Taipei China in 1997, there has been a long-term reduction in the importation of soybean meal (Fig. 4). Alternative markets in which the soybean meal could be sold had to be identified, resulting in transaction costs associated with finding and supporting the new markets. These types of impacts can be minimised through preventing disease outbreaks and establishing alternative

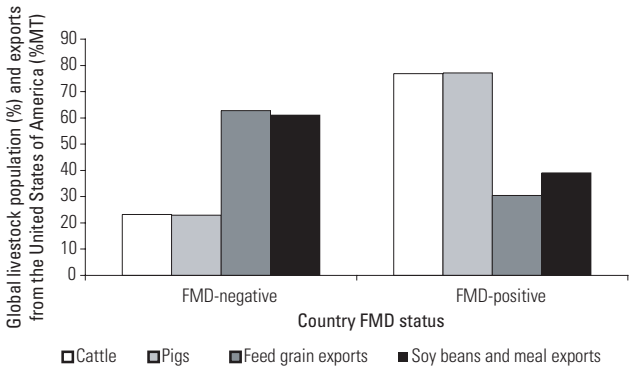


Fig. 3
Global livestock populations and feed exports from the United States of America – countries grouped by foot and mouth disease status (five year mean, 1997-2001)
Source: OIE Handistatus II, USDA-ERS FATUS database

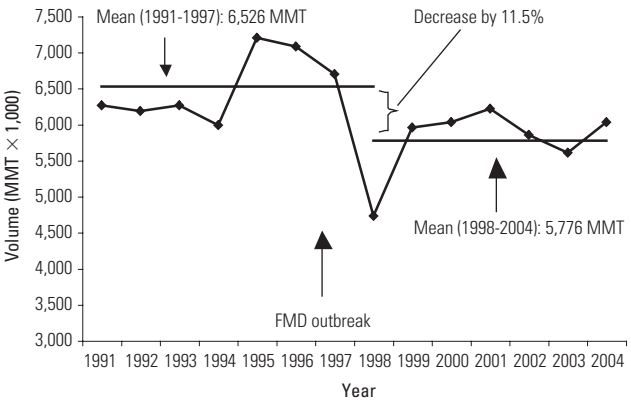


Fig. 4
The reduction in the importation of soybean meal following the 1997 foot and mouth disease outbreak in Taipei China

markets ahead of time by creating strategic alliances with trade partners and allied private sector industries. By engaging the private sector, which responds more rapidly to market demands than the public sector, it is also more likely that early indicators of the successes and failures of animal and public health service programmes will be detected at a time when corrective actions can keep the programmes on course.

Disease outbreaks (intentional introductions)

Many of the same factors that are involved in a naturally occurring disease outbreak will also be associated with an intentional introduction of a disease. However, any discussion about intentional introduction of an animal disease should first take several considerations into account, including:

– Would an intentional introduction of a disease be industrial sabotage or terrorism?

– Why would a particular group/organisation/person intentionally introduce a disease?

– Who is the most likely perpetrator - foreign or domestic?

– How will the attacked country react?

Because the answers to these questions are different for each country, not all countries are at equal risk of being a target and the consequences of a deliberate introduction of disease will differ between countries.

Industrial sabotage

The motivation to commit an act of industrial sabotage is to gain a competitive advantage over another country or industry, such as by capturing the affected country's or industry's market share. However, reviews of previous disease outbreaks indicate that changes in market share cannot be predicted or assured. Hence, the potential for success of an industrial sabotage operation is limited. History supports this view and has shown that there have been very few, if any, proven attempted, let alone successful, cases of industrial sabotage in agriculture.

Terrorism

The motivation to commit an act of terrorism is different from the motivation to commit an act of industrial sabotage. Terrorists aim to shock persons, institutions, and governments with a different world view and, at the same time, compromise the persons and organisations that are the target of the attack. The degree of damage that a terrorist could inflict in a country using a biological agent that the country is already infected with is limited. Therefore, terrorists are most likely to attack countries with disease agents that do not already exist in the country. Because most low-income countries have a poor livestock disease status, these countries are unlikely targets for terrorism.

Attribution

Much of the impact of terrorism is the shock value and the identification of the cause or perpetrator. Attributing the introduction of a disease to a perpetrator would probably significantly facilitate response efforts by providing valuable information on when and where the disease was introduced. By getting intelligence needed to rapidly identify and control the spread of disease, the scope of the attack would probably be reduced.

International versus domestic terrorism

Because most developed countries will, in the foreseeable future, always have a sufficient food supply through domestic food production and international trade, a terrorist attack against agriculture in a food exporting country with disease free livestock would probably have a limited direct impact on the country's domestic food supply. However, agroterrorism would probably have far reaching consequences for the countries that depend on food exports from the affected countries. If food shortages were to arise, the food exporting country would simply divert food destined for export back into the domestic markets. An alternative scenario arises in affected countries that produce food in excess of domestic consumption and are trade restricted. The affected countries in this situation would seek alternative markets in which the disease does not present an added risk to the importing country. For example, when Argentina became infected with FMD in the early part of the century, beef that could not be sold in FMD free markets was sold to Peru, where little to no additional risk existed from importing beef from another FMD infected country. Also, producers could restrict production until the markets reopen. In either scenario, terrorism against agriculture in countries with excess food production would hurt the affected countries less than it would hurt their trade partners. Hence, an attack against agriculture in a high-income country would be disproportionately detrimental to the developing countries that rely on imports from the affected country. Assuming international terrorists have an understanding and appreciation for the interconnectedness of global economies, including agriculture, limits the likelihood that foreign terrorists will target agriculture in high-income food exporting countries.

There is a much greater potential for a domestic versus international terrorist attack against the agriculture sector of high-income countries. Domestic terrorists cannot be assumed to appreciate the global interdependencies of food production and may actually be opposed to the agricultural practices that underlie the global food supply. Being opposed or oblivious to the global relationships makes domestic terrorists the most likely perpetrators of an intentional introduction of contagious disease to disease-free countries. It is clear from statements made by some animal rights groups (that would rejoice at the introduction of a livestock disease, thinking it would disrupt or stop intensive agriculture), that the greatest threat to agriculture is domestic in origin. This is a threat that is more or less exclusive to high-income countries.

Reaction

The impact of terrorism depends to a large extent on the reaction to an attack. An example of a poor reaction to a biological attack was the response to the release of small amounts of anthrax in the USA in 2001. It should have been clear from scientific data available at the time that the case fatality, even for 'weaponised' anthrax, is low (< 1:1,000) (6). Although great effort was made to identify and treat all persons known to be at risk, many other actions were undertaken without first attempting to get a clear understanding of the actual risks of infection or benefits of the responses. Even now as officials conclude, from reviewing the attacks and extrapolating from the two outlier cases, that tens of millions of Americans were probably exposed to anthrax spores via their mail and remained healthy, there remains an irrational interest in anthrax and, with that, huge opportunity costs to other aspects of animal and public health services, such as programmes for the control of preventable diseases and the infrastructure needed to deliver these programmes.

The role of animal and public health services in combating terrorism

Because the tactical aspects of a response to an intentional and accidental disease outbreak are the same and depend on factors such as a country's level of preparedness, resources, and political will, the future role for animal and public health services will be to provide the framework for strategic counterterrorism. Developing such a framework begins by accepting that an inappropriate response to terrorism brings with it much greater adverse consequences than the impact of an actual terrorist attack. An inappropriate response results from the failure to realise that terrorism is rooted in differences in philosophical values, and is fuelled by a politicized understanding of risk.

Terrorism (and martyrdom) has occurred throughout history during times of rapid changes in the predominant economic power, and with that, changes in the predominant culture. Many of the countries that have recently given rise to terrorists are low-income countries where there is little opportunity for prosperity and where there are large numbers of young unemployed people. Widespread access to the internet means that they are well aware of the wealth and choices available in high-income countries and the impact of this is an increasing sense of resentment towards those who live in high-income countries. This resentment is enabled by a lack of government support for (science) education. The lack of investment in education results in religious institutions assuming the role of educators and curricula being driven by the values of extremely motivated spiritual leaders.

Because the philosophical basis for terrorism is not rational, and, hence, terrorists cannot be reasoned with, the only long-term solution to terrorism is to change the environment that leads to the mind-set of a terrorist. Animal and public health communities can help to achieve this objective by creating and supporting an environment that promotes equitable job growth and economic opportunities, especially in countries with deteriorating economic status. Specifically, animal and public health services can help reduce terrorism by generally supporting investments in science education in low-income countries.

Science education can also reduce the consequences of terrorism in high-income countries where there is a need to reinforce the scientific meaning of risk. Risk should be defined as the probability of consequences based on the product of the likelihood of a hazard and the vulnerability of a country/industry to adverse events, including acts of terrorism. Unlike the political use of the term risk, which often equates to an imprecise or indefinite eventuality or threat, science education in general and scientific understanding of risk allows countries to meaningfully identify and prioritise the threats and the actions needed to reduce all countries' vulnerability to terrorism.

Natural disasters

Natural disasters are a burden to many countries and cause great tragedy. Natural disasters affect animal and public health in two ways. First, disasters, such as droughts and floods, can have a significant effect on animal movements and, therefore, disease spread. The classic example is the rinderpest pandemics in Sub-Saharan Africa following the droughts in the early 1980s. The droughts during this time led to increased animal movement and congregation at watering holes, which, in turn, increased animal contact and the spread of disease. Secondly, damage to the animal and public health infrastructure as a result of a natural disaster and preoccupation with response efforts can seriously compromise the capability of these services to

identify and control disease. To be prepared, animal and public health services should include emergency preparedness into programme continuity planning and develop excess capacity to be able to operate under conditions of sudden resource constraint.

Priorities

It is not possible to predict the future, however, knowledge of past, present, and predicted trends can help anticipate the events that are likely to occur as a result of ongoing trends. So far much of the focus of this paper relates to highly contagious diseases (of trade) and the role of animal and public health services in responding to outbreaks of these diseases, but there are many other diseases that will affect the future of animal and public health services that receive little attention. These diseases deserve more than a mention as they may emerge as one of the world's most significant concerns over the next two decades.

Insidious disease

In developing and developed countries insidious disease may pose a larger problem than many other topics discussed in this paper so far. Insidious diseases may be difficult to recognise early, their impact is often delayed, and it is difficult to garner political support for their control. The emergence of bovine spongiform encephalopathy in the UK in the 1980s may be the best current example of the difficulty in acting quickly enough to control the spread of an insidious disease at a time when huge negative impacts could have been averted.

But the question is, have we learnt from the British experience or are we overlooking another insidious emerging disease already among us? We may not know, but a likely candidate is Johne's disease. If Johne's disease were introduced into Africa and Asia it could have devastating effects on livestock and human health through lost livestock productivity, decreased protein availability and significant job losses from the value added chain. If Johne's disease were to also affect wildlife species, the introduction of this disease to Africa could potentially change the diversity of wildlife forever and with that remove a significant source of tourist revenue from an entire continent. The identification and control of insidious disease will need to be based on scientific risk assessments so that critical diseases can be identified and prevented from spreading.

Zoonotic disease

As mentioned earlier zoonotic diseases are among the most important diseases to small-scale farmers in low-income countries, and because these farmers represent the largest number of agricultural workers in the world, animal and public health services must focus on the control and prevention of these diseases. Regrettably the three major zoonotic diseases, brucellosis, coenuriasis, and oncocerciasis, are chronic diseases and do not elicit significant attention from influential decision makers, who often rely on political and bureaucratic momentum to set priorities. Nevertheless, there are effective preventive interventions for the aforementioned diseases, and, therefore, top priority should be given to the control, if not global eradication, of these diseases. It is likely that the eradication of diseases, such as FMD, will not be possible unless the participation of owners of cattle with FMD is encouraged by linking FMD eradication with animal and human treatments against zoonotic diseases. This could be accomplished by offering simultaneous programmes for FMD eradication and control of zoonotic disease. In the case of bovine brucellosis, vaccine technology has progressed to a point where global eradication is possible, and if animal and public health services were to attempt to implement a global eradication programme they would probably gain tremendous access and support from many communities where other animal diseases are prevalent.

Conclusions

Poverty is prevalent in areas of low economic growth. Factors contributing to poverty are an unequal distribution of wealth and access to health, education, and economic opportunity, and, in poor countries with many natural resources, a highly skewed wealth distribution. Most rational people would probably agree that the growing discrepancies in wealth and basic opportunity in the world will have dire consequences if left unchecked over the next two decades. Therefore, the challenge facing animal and public health professions is to recognise and anticipate likely changes and to adjust their modus operandi in such a way that all countries, industries, and populations benefit from the structure, effectiveness and relevance of the animal and public health professions.

Ways in which animal and public health services can build on existing strengths are by supporting policies that temper growing inequalities, such as providing preferential opportunities for low-income countries, rural populations, and women. Shifts in global trends in demand and supply, not terrorism, will drive the adaptation of animal and public health service delivery. To ensure that they are able to serve all parties equitably, animal and public health services will have to engage in an economic and social debate. To gain better support for disease control programmes, these services should create strategic alliances with private sector industries.

Veterinarians have traditionally seen the farmer as their customer because it is the animal owner who pays the practitioner's bills. This model is no longer sufficient for animal and public health services. To survive, or better yet, to become a leader, veterinarians will have to become part of a larger movement that contributes to global economic vitality. To assume such a role, government animal and public health services will have to find incentives and policies that encourage private sector veterinarians to play a significant part in supporting the global economy.

Animal and public health services can provide the framework for job growth in food safety and handling and support job growth along the value added chain in livestock production. To support environmental sustainability, the economic externalities of farm waste production has to be converted into jobs, such as by creating employment opportunities in waste management, recycling, and water conservation. As the use of land for agriculture increases, more people with animal and public health expertise will be needed to identify, respond to, and control new and emerging diseases that are encountered as pristine bat and other wildlife habitats are encroached upon, exposing naïve populations of humans and animals to diseases such as severe acute respiratory syndrome, Nipah virus, and Hendra virus.

The control and eradication of diseases of trade will not be possible unless the owners of animals afflicted with these diseases are also provided with animal and human treatments against zoonotic diseases. In the case of brucellosis, vaccine technology has progressed to a point where global eradication is possible. Global eradication of bovine brucellosis should become a high priority for animal and public health services in the next two decades.

Promoting access to health and education services in low- and middle-income countries results in a vigorous workforce and this may be the single biggest, albeit indirect, benefit that animal and public health services can provide over the next 20 years. Animal and public health services stand at a critical juncture where the challenge is to support not hinder progress. These services will hinder progress if they contribute to or exacerbate disparities in wealth, education, and access to economic opportunity between low and high-income populations. The services will support progress if they contribute to the proliferation of jobs within countries.

Whereas as at the beginning of World War II scientists argued that they were only responsible for getting the rocket into the air, by the end of the war scientists recognised that it was their moral responsibility to consider where the rocket will land. Whereas physicists have known for over half a century that they can use their discipline to either destroy the world or create wealth, biologists are only just now realising that diseases are powerful tools of destruction. It can only be hoped that the animal and public health communities will soon realise the role of their professions in the modern world and, following the lead of other scientists, use their knowledge to create wealth. The time has come for the animal and public health professions to enter into a debate on the socio-political impacts of the regulations and standards of disease control and to pursue policies that apply biological sciences to overcome the predicament of the 21st Century: disparate access to opportunity.

■

Les défis et les options pour les services de santé animale et de santé publique pendant les deux prochaines décennies

S.E. Heath

Résumé

Le commerce des animaux et des produits d'origine animale représente approximativement le sixième des échanges agricoles dans le monde. Ce commerce est tiré par la demande, principalement à cause de la croissance démographique, de l'évolution des économies et de la préférence des consommateurs dans les pays en développement. Les différences de taux de croissance démographique, de croissance économique, d'urbanisation, de viabilité environnementale et de transferts de technologie déterminent les pays qui vont récolter les plus grands bénéfices de cette situation. Ce sont les tendances mondiales de la demande et de l'offre de nourriture, et non le terrorisme, qui détermineront l'avenir de la prestation de services de santé animale et de santé publique.

Pour bénéficier au plus grand nombre de personnes et de pays, il faut que les services de santé animale et de santé publique soutiennent des politiques qui réduisent les disparités croissantes entre pays riches et pauvres, populations urbaines et rurales, hommes et femmes. La croissance économique est essentielle pour surmonter les disparités entre pays et elle repose sur l'intégration des politiques de la santé animale, de la santé publique, du travail et des relations avec l'étranger. Les possibilités de croissance de l'emploi seront les plus nombreuses le long de la chaîne de valeur ajoutée liée à la production alimentaire et elles nécessiteront des investissements importants dans l'éducation fondée sur la science (le risque).

Mots-clés
Bétail – Commerce – Croissance économique – Direction de l'environnement – Éducation – Femme – Pauvreté – Produit d'origine animale – Service de santé animale – Service de santé publique – Urbanisation – Valeur ajoutée.

Desafíos y alternativas para los servicios de salud pública y veterinaria en los dos próximos decenios

S.E. Heath

Resumen
El comercio de ganado bovino y sus derivados supone aproximadamente una sexta parte del comercio agropecuario mundial. Es una actividad muy dependiente de la demanda, tributaria esencialmente del crecimiento de las poblaciones humanas, la evolución de las economías y los nuevos hábitos de consumo en los países en desarrollo. De las distintas tasas de crecimiento demográfico y económico, urbanización, sostenibilidad ambiental y transferencia de tecnología dependerá a la postre cuáles sean los principales países beneficiarios. Serán las tendencias mundiales de la oferta y la demanda de alimentos, y no el terrorismo, las que determinen el rumbo futuro de la prestación de servicios de salud animal y de salud pública.
Para beneficiar al mayor número posible de personas y países, los servicios de salud animal y de salud pública deberían secundar políticas que redujeran las crecientes disparidades que existen entre países ricos y pobres, poblaciones urbanas y rurales, hombres y mujeres. El crecimiento económico es fundamental para superar las disparidades entre países, y la mejor forma de favorecerlo es la integración de las políticas zoosanitaria, de salud pública, laboral y de relaciones exteriores. Las oportunidades de creación de empleo serán inmejorables en los distintos eslabones de la cadena de producción alimentaria con valor añadido, lo cual, a su vez, exigirá importantes inversiones en una enseñanza que tenga en cuenta criterios científicos (de riesgo).

Palabras clave
Comercio – Crecimiento económico – Educación – Ganado – Gestión ambiental – Mujer – Pobreza – Producto de origen animal – Servicio de salud pública – Servicio de sanidad animal – Urbanización – Valor añadido.

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